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Overview of the Proterozoic evolution of the Lewisian Gneiss Complex, Scotland – constraints from the SE corner of Laurentia

Kathryn Goodenough (1), Maarten Krabbendam (1), and Quentin Crowley (2)

(1) British Geological Survey, Murchison House, Edinburgh, United Kingdom (mkrab@bgs.ac.uk), (2) Department of Geology, School of Natural Sciences, Trinity College, Dublin 2, Ireland

Prior to the opening of the Atlantic, the Lewisian Gneiss Complex in the NW Highlands of Scotland formed part of the Archaean-Proterozoic Laurentian craton. Over the last decades a large number of geochronological studies have elucidated its evolution, as summarised by Kinny et al. 2005. The Lewisian thus provides an important link between Laurentia and Baltica during the Proterozoic

Most of the Lewisian Gneiss Complex was formed during the Meso- to Neoarchaean, as a series of crustal terranes that were largely amalgamated at the end of the Archaean to form part of the North Atlantic Craton. During the Proterozoic, numerous igneous, tectonic and metamorphic events have affected and reworked the complex; these can be linked to similar events in mainland Laurentia and/or Baltica. Here, we provide an overview of the Proterozoic history, based on information from the literature and new geochronological data (Goodenough et al. in press).

Juvenile magmas were emplaced into many parts of the Lewisian Gneiss Complex in the period c. 1900-1870 Ma, followed locally by high-grade metamorphism. Magmatism at this time has now been recognised along most terrane boundaries in the Lewisian. Some distinct terranes with arc-like characteristics are recognised (Loch Maree Group, South Harris Complex) whereas elsewhere granitoids intruded into Archaean crust (Laxford Shear Zone). This magmatic activity was related to the development of continental arcs during the accretion of the Columbia supercontinent, and may be correlated with the Ketilidian or Nagssugtoqidian events in Greenland and the Svecofennian and Lapland-Kola belts in Scandinavia.

Subsequently, the Lewisian Gneiss Complex was affected by a crustal thickening and heating event (or events) during the period 1770-1650 Ma. This period is characterised by amphibolite-facies metamorphism, shearing (typically sinistral strike slip or transpression) and intrusion of largely crustal-derived granite and pegmatite sheets. Again, these events affected pre-existing Archaean rocks and probably represent the distal effects of more active margins, positioned farther south along the edge of the Columbia supercontinent. Broadly coeval events are the Labradorian and late-TSIB to Gothian events in Laurentia and Baltica respectively.

Cooling, uplift and erosion followed into the Mesoproterozoic, with development of rift zones within the supercontinent. In NW Scotland, the Stoer Group sediments were deposited unconformably upon the Lewisian Gneiss in a rift setting at c. 1180 Ma and have not been metamorphosed since. This rift is broadly coeval with the later phase of magmatism and sedimentation in the Gardar Rift of SW Greenland.

During the Grenville orogeny, the Lewisian Gneiss Complex was affected by brittle deformation. Metamorphism was restricted to the Glenelg Inlier in Scotland, which contains Grenvillian eclogite, but this inlier is allochthonous and has been transported significantly by subsequent Caledonian thrusting. The Lewisian Gneiss at this time formed the basement to the Moine and Torridon Group sediments, the probable foreland basin to the Grenville orogen.

Overall, the Lewisian Gneiss Complex records many of the major events associated with formation and break up of the Columbia Supercontinent, and subsequent formation of Rodinia. It thus provides a useful piece of the jigsaw from the Laurentian margin.